University of Cambridge
School of Agriculture Memoirs

Memoir No. 9

A brief summary of the papers published by the Staffs of the School of Agriculture and its Associated Research Institutes during the period Oct. 1st, 1936—Sept. 30th, 1937.

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FOREWORD.

This Memoir, which is published under the general editorship of the Librarian of the School, represents an attempt to present as succinctly as possible the contributions made by members of the Staffs of the School of Agriculture and its Associated Institutes to the development and progress of Agricultural Science, to indicate to research workers interested the Journals in which the full papers are presented and to act as a complete record of papers published. Each summary is compiled by the author of the paper and is presented, so far as the subject matter will allow, in a non-technical form in order to be of value to the general body of farmers interested in the more recent developments of agricultural scientific research in general and of the activities of this Department in particular.

Requests for further information or criticism arising out of the summaries should be referred to the individual author concerned, criticisms and suggestions for the improvement of the Memoir itself should be addressed to the Librarian of the School.

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University of Cambridge School of Agriculture Memoirs

THE SCHOOL OF AGRICULTURE INCLUDING ESTATE MANAGEMENT, THE ADVISORY SERVICES AND ASSOCIATED RESEARCH INSTITUTES

Agricultural Education in Cambridge dates from 1892 *when the Cambridge and Counties Agricultural Education Committee, an informal body consisting of University Professors and County Council representatives, first organized an Agricultural Course. In* 1899 *the University created a Department of Agriculture to take over the work of this Committee. The School of Agriculture was built by public subscription in* 1909 *and expanded by a grant from the Development Commission in* 1912. *The rapid expansion of the Animal Nutrition Institute and the Plant Breeding Institute under the direction of Professor T. B. Wood and Professor R. H. Biffen led to increased demands on accommodation, and an extension to the building was made in* 1925–26 *by the aid of a further grant from the Development Commission. The Estate Management Branch has been added since the war for the purpose of providing technical and professional assistance in the management of University and College property and with a view to affording opportunities for practical demonstrations in connection with the teaching of Estate Management subjects.*

The Rockefeller Benefaction, made to the University in 1929, *provided money for additional accommodation for the Department of Agriculture and for an expansion of its activities, and a new building was completed and occupied in March,* 1933.

The Department of Agriculture is a teaching department of the University and offers courses of instruction leading to a degree or a post-graduate diploma. Research in the problems of agriculture and cognate sciences is carried out by members of the teaching staff and by members of the staffs of the Research Institutes attached to the Department. There are also a number of Advisory officers who are available to offer assistance and advice to farmers on their problems. Additional facilities for both teaching and research are provided by the University Farm which occupies an area of some 700 *acres within reasonable distance of the scientific laboratories.*

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AGRICULTURE.

504* CULPIN, C.

Studies on the Relation Between Cultivation Implements, Soil Structure and the Crop. III. Rolls.

J. Agric. Sci. 1937, **27,** 432–446.

An account is given of methods which have been employed in laboratory and field studies of the actions of rolls on the soil. These studies have revealed little that is remarkable or unexpected concerning the actions of rolls on the soil, but they have clearly demonstrated that the exact actions of rolls differ widely according to the circumstances in which they are employed. When rolling is carried out in field experiments, it is necessary to perform tests to measure the exact effects produced on the soil. In this way is should gradually become more apparent when and how rolling is likely to be beneficial.

Of the methods which have been described the last two, viz. tests of the consolidation, moisture content and tilth by means of a sampling tube, and of the mechanical resistance to the penetration of a probe with the automatic " resistance " recorder, are well adapted to use in field experiments. These methods are being used in many field experiments involving cultivations, and it is hoped that at some time in the future it may be possible by such methods to relate cultivations with crop yields through a knowledge of the soil structure.

CULPIN, C.

Some Modern Cultivation Problems.

2nd Conf. Mech. Farm. Oxford, 1937. pp. 35–49.

During recent years cultivation experiments on important crops in other countries have shown that deep or often-repeated cultivations are frequently a waste of time and money. The experiments described in this paper, and modern thought on the subject of cultivations generally, suggest the possibility that provided rubbish is buried, seeds are covered so that germination is ensured, and weeds are kept down, the cultivations employed in the growing of our crops may matter little, and the cheapest methods may be the best.

506* GARNER, F. H. and SANDERS, H. G.

On the Spring Cultivation of Autumn-sown Wheat.

J. Agric. Sci. 1937, **27,** 447–457.

Experiments have been conducted on heavy gault clay and on a gravelly loam to determine the effects of rolling and harrowing autumn-sown wheat in spring. It is concluded that rolling has no effect on yield on such soil types. In general, harrowing also had little effect on yield, although on three occasions it significantly increased the weight of grain per ear in excess of the increment to be expected from its effect on ear number.

459* Hanley, F. and Tunnington, F.

Experiments on the Growing of Chicory (for Drying).

Emp. J. Exp. Agric. 1936, **4,** 379–384.

Experiments failed to show any large response by the chicory crop to applications of complete artificial fertilizers, and no special requirement by the crop for any one particular element of plant-food more than any other on soils in a normal state of fertility. No evidence was obtained to support the practice of withholding part of the nitrogenous dressing till singling time, and it is suggested that a moderate dressing of a complete fertilizer, such as that commonly used for the sugar-beet crop growing under similar conditions, is suitable for the chicory crop, the whole application being worked into the soil prior to seeding.

Spacing trials showed that considerable increases in yields were obtained where close spacing was adopted. The effect of row-spacing was particularly pronounced.

Soil acidity has been shown to cause serious reduction in the yield of the chicory crop.

On gravel-loam soils in normal condition, average yields of 10 tons per acre of chicory roots can be obtained under ordinary farming conditions. On good fen soils yields should reach 15 tons per acre.

Experience gained in the course of these trials has shown the great importance of careful preparation of a good seed-bed and early and careful singling of the crop.

482* Mansfield, W. S.

Notable Farming Enterprises. VII. Cambridge University Farm.

J. Roy. Agric. Soc. 1936, **97,** 95–112.

A description of the system of management employed on the Cambridge University Farm.

494* Salaman, R. N.

The Potato in its Early Home and its Introduction into Europe.

J. Roy. Hort. Soc. 1937, **62,** 61–77, 112–123, 153–162, 253–266.

This is the result of some twenty years research on the pre-history of the potato. The sculptured pottery found in the cemeteries on the coastal plains of Peru executed by the early inhabitants from about the beginning of this era up to the coming of the Spaniards, forms the basis of the knowledge won as to its culture and use. A theory is put forward to explain the peculiar symbolism exhibited on these ceramics. The potato is shown to have been one of the important factors influencing the dispersion of early man in South America. The introduction of the potato into Europe is considered in detail.

Salaman, R. N.

The Potato Makes History.

Camb. Univ. Agric. Soc. Mag. 1937, **5** (No. 2), 8–12.

A short account of the reaction on British political life brought about by the failure of the potato crops in Ireland and the subsequent famines in 1845 and 1846.

480* Woodman, H. E.
Grass-Drying.
Fertil. Feed. St. J. 1937, **22,** 221–228.
This paper presents in compact form a survey of the present position regarding the feeding value etc. of young grass.

OTHER PAPERS.

Biffen, R. H.
Annual Report for 1936 of the Botanist.
J. Roy. Agric. Soc. 1936, **97,** 480–485.

490* Buttress, F. A.
Thomas Tusser. 16th Century Agriculturalist. (Illustrated)
East Anglian Mag. July, 1937.

Garner, F. H.
Preparing Cows for Show.
Fmr & Stk-Breed. 1937, **51,** 912.

Garner, F. H. and Sanders, H. G.
Should Wheat be Rolled or Harrowed?
Fmr & Stk-Breed. 1937, **51,** 856.

Mansfield, W. S.
Wheat : Yield the Main Thing.
Fmr & Stk-Breed. 1936, **50,** 2377.

Sanders, H. G.
Experiments on Cultivations.
J. Chart. Surv. Instn. 1937, **16,** 701–705.

Woodman, H. E.
Farm Grass-Drying : Its Origin, Present Position and Future Prospects.
Fmr & Stk-Breed. Yearb. 1937, pp. 148–150.

AGRICULTURAL ECONOMICS.

Changes in the Economic Organisation of Agriculture—A Comparative Study of Conditions in the Eastern Counties of England in 1935 and 1936.
Fm Econ. Br. Rep. No 24. Pp. vi + 38. Price 1/6 net. Postage 2*d.*
This Report compares the organiatzion and financial results of an identical group of 200 farms in 1935 and 1936. The sample comprises commercial diversified livestock and crop farms over 20 acres in size, and has been selected at random from four important " type of farming " districts within the Eastern Counties. The results here shown are probably reasonably representative of the financial and economic changes which have taken place within the types of farming covered, but do not claim to describe conditions throughout the Province as a whole.

Of the 200 farms comprising the sample 35 per cent. had an appreciably better year in 1936 than in 1935, 21 per cent. had a worse year, while 44 per cent. experienced no marked change one way or another. On the average, the profits in 1936 were higher than in 1935, but it is important to note that the improvement is confined almost entirely to one of the four " type of farming " districts investigated. Farms on the central Norfolk medium loans actually show a decrease in profits ; on the arable clays of north Essex and south-west Suffolk and on the south Essex pasture clays only a small improvement is recorded ; profits on the south Cambridge chalk lands alone show a substantial increase. If due weight is given to the fact that in the Eastern Counties there is a much larger area of medium loam soils and arable clays than of pasture clays and light chalk soils, then it may be hazarded that for the Province as a whole (excluding the Fens) farm profits in 1936 were similar to those of 1935.

The reasons for the changes in profits within the various districts are complex. The deterioration in central Norfolk is mainly due to a reduced income from wheat and pigs, coupled with higher expenditure on feeding stuffs. The slight improvement on the north Essex and south-west Suffolk arable clays can be largely attributed to an increase in the receipts from livestock which has more than off-set the decline in income from wheat. In the south Essex pasture clay district the small improvement in profit is mainly due to an increased income from milk. The very substantial betterment on the chalk lands of south Cambridge is caused chiefly by larger receipts from barley.

The quantitative output of milk increased in 1936, but that of pigs, horned stock, and eggs declined. Collectively the quantitative output of all livestock and livestock products in 1936 was 3 per cent. less than in 1935. The quantity of wheat, oats, and hay sold declined, but that of barley, sugar beet, and potatoes increased. Taking all crops together the quantity sold in 1936 was 1 per cent. greater than in 1935. Direct combination of these two estimates suggests that the quantitative output of crops and livestock on these 200 farms was 1 per cent. less in 1936 than in 1935. Although the year 1936 is thus the first since 1931 that shows evidence of contracting quantitative output, the *value* of the output continued to rise as a result of better prices.

The number of workers employed on these 200 farms was 2 per cent. less in 1936 than in 1935, and the output per worker thus continued to increase. The quantity of concentrated feeding stuffs purchased in 1936 was 6 per cent. greater than in 1935, while the quantity of inorganic fertilizers bought was 5 per cent. greater. The area from which crops were cashed direct in 1936 was somewhat smaller than in the previous year. This is the first time since 1931 that a contraction of the " cash crop " area has been noted in these surveys.

Farm Adjustments Raise Profits.

Fm Econ. Br. Fmrs' Bull. No. 6. Price 6*d*. Post Free.

The purpose of this Bulletin is primarily to interest farmers in the changes which are taking place in farm organization to meet new price and cost conditions. Statistics are reduced to a minimum and the practical aspects are stressed. A description is given of the changes which have been made in the organization of certain individual farms in recent years, and resulting in better profits.

CARSLAW, R. McG.
Fertilizers are a Sound Investment.
Fmr & Stk-Breed. 1937, **51**, 469.

489* CARSLAW, R. McG. and CULPIN, C.
Labour, Power and Equipment on Arable Farms.
J. Roy. Agric. Soc. 1936, **97**, 12–32.

It is generally realized that power and equipment costs constitute an increasing proportion of total farm production costs, and that these costs vary widely from farm to farm. But except in the case of a few special farms employing spectacular or experimental equipment, there is little information concerning the kind of appliances with which farms are equipped, or the effects of the use of various items of equipment upon one another and upon the general farming organization. The object of this study is to bring forward some facts on the subject.

The considerations involved in the purchase of new equipment are discussed under various headings. It is emphasized that though a certain machine may in theory economize in man and horse power, its use will actually decrease the net farm profit unless it permits *total* farm income to be increased *relative* to total farm costs.

In the eastern arable counties of England the capital value of implements, machinery, and equipment averages roughly £2 per acre of crops and grass, and represents nearly 20 per cent. of tenant's total capital. Current expenditure on the maintenance and running of equipment averages about 20/- per acre. The value of the output per £100 total labour and equipment costs increases directly with the size of farm, but at a decreasing rate.

There is a wide gap between the " available " and " effective " power on farms. Tractors appear to be worked at less than 30 per cent. capacity, fixed engines at less than 20 per cent. capacity, and horses at about 70 per cent. capacity. Combining these three forms of power, it is estimated that the average number of horse-power hours worked on farms is less than half full capacity. On this basis agriculture has yet far to go in its search for ideal power units.

509* CARSLAW, R. McG. and GRAVES, P. E.
The Changing Organisation of Arable Farms.
Econ. J. 1937, **47**, 481–499.

This article compares the quantitative and financial changes occurring during the five years 1931 to 1936, on an identical group of 150 farms. From the data adduced it is suggested that the period may well be considered as one of unprecedented rate of change in the internal, as well as external, organization of British farming. Both the value and volume of the output from the farms investigated increased substantially, the former at the rate of 8 per cent. per annum and the latter at 4 per cent. per annum. This expansion in output was achieved in spite of a reduction in the number of workers employed, so that output per worker increased even more markedly than output per acre (see table). During the same period the number of work horses decreased by 17 per cent., while the number of tractors increased by 50 per cent.

Output per Acre and per Worker
(Data based on an identical sample of 150 farms)

Year	Value of Output		Volume of Output	
	per acre	per worker	per acre	per worker
	Index	Index	Index	Index
1931	100	100	100	100
1932	104	107	110	114
1933	123	127	117	121
1935	136	144	122	128
1936	142	150	119	127

Details are provided of the changes in cropping, crop sales, and livestock production by which the increased output was obtained. The area under " cash crops " rose from 34 per cent. of the farmed area in 1931 to 42 per cent. in 1936, while the quantity of crops sold increased by 40 per cent. Rising numbers of livestock, coupled with larger sales of crops resulted in an increase of 46 per cent. in the quantity of animal feeding stuffs purchased. The quantity of fertilizers purchased rose by as much as 51 per cent.

Profits improved substantially between 1931 and 1933, but advanced only slightly after that year.

CARSLAW, R. McG. and GRAVES, P. E.
The Changing Organisation of Arable Farms.
Fm Econ. 1936, **2,** 73–74.

CARSLAW, R. McG. and GRAVES, P. E.
The Condition of Farm Buildings.
Fm Econ. 1936, **2,** 101–102.

484* ENGLEDOW, F. L.
Quality in Food from the Agricultural Point of View.
Chem. & Ind. 1937, **56,** 459–462.

Current ideas about quality of food are in confusion mainly because grading and packing have been primarily considered as constituents of quality, true quality, which is essentially physical and bio-chemical, having been neglected. The nature of quality for various kinds of plant and animal products is discussed and suggestions are made for the building up of standards of quality.

The present situation of misunderstanding is probably to the advantage of the distributor, but much against the interest of the primary producer.

473* Graves, P. E.

Parish By-Ways.

J. Minist. Agric. 1937, **43,** 1131–1138.

This article summarizes the results of an investigation of the road facilities in a Cambridgeshire parish. More than half the area of the parish is served with private roads, of which there are 17½ miles. The surfacing of only about half a mile of this compares favourably with the lesser public roads, and the remainder represent no more than dusty by-ways in summer turning into mud tracks during winter. The land approached by 5 miles of these by-ways is now rated at 1/- per acre for the purpose of repairs and maintenance, while the remaining 12 miles are completely neglected. There is no doubt that the bad state of such communications has a detrimental effect on the agriculture of the district.

Menzies-Kitchin, A. W.

What is a Pig House Worth?

Fmrs' Wkly. 1937, **6** (No. 8), 24–25.

Menzies-Kitchin, A. W. and Taylor, S.

Housing as a Factor in Pig Production.

Fm Econ. 1936, **2,** 77–79. Reprinted in *Pigs and Pig Prod.* 1937, **5,** 353–354.

500* Pettit, G. H. N.

Cost Records as an Aid to Profitable Milk Production.

Rep. Cent. Coun. Milk Rec. Soc. 1936. pp. 37–42.

AGRICULTURAL ZOOLOGY (Including Entomology).

Petherbridge, F. R.

The Cabbage Aphis Problem.

Horticulturalist. 1937, **23** (No. 4), 11–13.

Husbandry. 1937, **7,** 53–55.

Petherbridge, F. R., and Stapley, J. H.

Cutworms as Sugar-Beet Pests and their Control.

J. Minist. Agric. 1937, **44,** 43–49.

Cutworms of the Turnip Moth (*Euxoa segetum*) feed on sugar-beet from the end of June until lifting time.

Cutworms of the Garden Dart Moth (*E. nigricans*)—hitherto unrecorded as a beet pest—caused severe damage to beet seedlings in the fens in 1935 and 1936. This damage is caused in May and June.

Experiments show that both species are readily controlled by poison baits.

Petherbridge, F. R. and Stapley, J. H.

Observations and Experiments on Pests of Sugar Beet in England during 1936.

Paper No. 84. *Minist. Agric. and Fish. Sugar Beet Res. and Educ. Comm.* (Not available for general circulation).

The cutworm *Euxoa nigricans* caused considerable damage to sugar beet seedlings in the Ramsey district of Hunts. Experiments with poison baits showed that

infestations could be satisfactorily reduced. Caterpillars of the Silver Y Moth (*Plusia gamma*) were extremely common in the Eastern Counties, causing severe leaf injury in July and August. Experiments at several centres on the control of Pigmy Mangold Beetle (*Atomaria linearis*) showed that a satisfactory stand could be obtained by increasing the seed rate, but that the seed treatment used was of little value. Experiments on the control of wireworm yielded few results but the drilling of wheat between the rows of sugar beet increased the stand in one case. Particular attention was paid to the sugar beet eelworm (*Heterodera schachtii*), new records of infected and beet sick fields being made. Figures are given showing the fluctuations in eelworm population in fields under different cropping. A list of host plants is given.

WARBURTON, C.
Annual Report for 1936 of the Zoologist.
J. Roy Agric. Soc. 1936, **97**, 486–492.

ANIMAL BREEDING AND GENETICS.

469* HAMMOND, J.
Breeding Experiments.
Shorthorn Breed. Rev. 1936, pp. 95–100.
(Spanish Translation in "*La Res*" 1937, **5** (No. 83), 5071.
A popular account of the part science has to play in the improvement of breeds —Effects of the planes of nutrition on selection for beef and milk; elimination of defective recessive characters; progeny tests; and the use of artificial insemination in making the most of proven sires.

474* HAMMOND, J.
Cruzas y razas de Orinos referidos a la produccion de lana y de Carne.
Sociedad Rural Argentina, 24 Sept., 1936: and *La Res.* 1936, **4**, (No. 67).
A description of the methods used in breeding for wool and fat lamb with special reference to conditions in the Argentine. Stratification of the industry in time and space: ram and ewe producing breeds; fertility and milk supply; breeds; and crossbreeding are among the problems dealt with.

464* HAMMOND, J.
Environmental Conditions and Livestock Breeding.
Probl. Anim. Husb. Moscow, 1936, No. 8, p. 101.
A survey of the part environmental conditions play in the improvement and production of livestock is discussed under the following headings:—Breed improvement; body size; stratification; creation of new breeds; type of production; and evolution of domestic needs.

460* HAMMOND, J.
Fecundacion Artificial.
Bull. No. 10, *Fac. de Agron. y Vet. Univ. Buenos Aires*, 1936: and *La Res.* 1936, **4**, (No. 65).
A summary of the history and applications of artificial insemination, together with the methods of collecting semen, insemination, and the species differences in semen.

PEASE, M. S.

Breeding Problems.

Rep. Refresher Course Co. Poult. Instr., Harper Adams Agric. Coll. 1937, pp. 1–5.

Data are here presented to show that mortality of both chicks and adults hatched from pullets which lived at least one year after the date of their first eggs was equal to the mortality of the progeny of hens and older birds. But the mortality of both chicks and adults in the progeny of pullets which died before the end of their first laying years was very much greater. It appeared that the death or survival of the *male* parent had no effect on the mortality of his progeny ; this could not be explained as due to genes in the unpaired sex-chromosome.

463* WALTON, A.

Notes on Artificial Insemination of Sheep, Cattle and Horses.

Holborn Surgical Instrument Co. Ltd., London, 1936. Pp. 1–19.

These notes are published as a guide to the care and use of the instruments employed in artificial insemination. They are not intended to be exhaustive treatises on the subject and only touch here and there upon scientific principles. For fuller information a short bibliography is published. The notes are illustrated to show the principal method of collection of sperm in sheep and cattle. There is a complete priced and illustrated catalogue of instruments.

457* WALTON, A. and PRAWOCHENSKI, R.

An Experiment in Eutelegenesis.

J. Hered. 1936, **27**, 341–344 : and *Mem. Inst. polon. Econ. rur.* 1936, **16**, 265–276.

Semen from a Suffolk ram at the Animal Research Station, Cambridge University, England, was obtained by means of an artificial vagina and sent packed in ice in a " Thermos " flask by air mail to Warsaw and used to inseminate five Polish ewes at the Zootechnical Institute at Borowina. The entire journey occupied two days, three hours. Two ewes subsequently proved to be in lamb. One ewe aborted before term ; the other produced a ram lamb. Suffolk characters were clearly seen in this lamb and the male parentage is beyond dispute. This experiment demonstrates the practical possibility of transporting semen considerable distances.

OTHER PAPERS.

458* GARNER, F. H.

The Case for Official Recording and Butter-fat Testing.

Dairy Shorthorn. J. 1936, **5**, 427–430.

PEASE, M. S.

Simple Mendelism for Breeders.

Feath. World. 1936 (No. 2471), 446–447.

Reprinted in *Feath. World Yearb.* 1937.

ANIMAL NUTRITION.

478* CRUICKSHANK, E. M.

A Note on the Effect of Different Cereals in the Fattening Ration on the Composition of the Body Fat of the Fowl.

J. Agric. Sci., 1937, **27**, 309–315.

Over a 12-day fattening period the use of maize in the poultry fattening ration has no detrimental effect on the consistency of the body fat.

When fattening is rapid and live weight gains are satisfactory, the type of fat deposited in the bird is harder than that laid down on a normal ration containing mixed cereals and a protein supplement.

476* CRUICKSHANK, E. M. and MOORE, T.

The Effect of the Administration of Large Amounts of Vitamin A on the Vitamin A Content of the Hen's Egg.

Biochem. J. 1937, **31**, 179–187.

The administration of cod liver oil to a laying hen at the rate of 10 per cent. of the diet, which was otherwise low in vitamin A and carotene, caused the vitamin A content of the eggs, as determined by the antimony trichloride method, to be doubled. The vitamin A content of the egg resumed its normal level soon after the withdrawal of the cod liver oil from the diet.

The intensive administration of a vitamin A concentrate raised the concentration of vitamin A in the egg to about five times the level found on the basal diet alone. In this experiment the limits of absorption by the intestine appeared to have been reached, since a considerable proportion of the ingested vitamin was recovered from the excreta.

In spite of these considerable increases in the vitamin A content of the eggs the proportion of the vitamin A ingested which appeared in the eggs amounted to only 2 per cent. and 0·2 per cent. for cod liver oil and concentrate feeding respectively. The transference of vitamin A to the egg is therefore limited, and decreases as the intake increases. This limited transference of vitamin A to the egg recalls the similar limitation which is usually found in the amounts of vitamin A made available to the young animal during pregnancy and lactation.

At the conclusion of the egg-laying experiments the hens were killed and the distribution of vitamin A in the various organs determined. High concentration of vitamin A was found in the liver. Much lower, but still considerable concentrations were found in the kidneys. In the other organs examined negative results were obtained in the case of the bird given cod liver oil, while small traces were found in some organs of the bird given concentrate. These results suggest that the rôle of the liver in the vitamin A economy of the bird is essentially the same as in the mammal.

467–468* HALNAN, E. T.

Digestibility Trials with Poultry. VII–VIII.

J. Agric. Sci. 1937, **27**, 126–136, 137–142.

The results of digestibility determinations of broad bran, straight-run middlings, fine middlings, and dried molassed sugar beet pulp are given, and the value of these materials for inclusion in poultry dietaries critically considered.

HALNAN, E. T.

Essential Points in Poultry Feeding.

Minist. Agric. Adv. Leafl. No. 90, 1937. Price 1*d.* net.

Contains a simple explanation of the points to be observed in poultry feeding, and a selection of specimen rations for use under varying management conditions.

HALNAN, E. T.

Scientific Principles of Poultry Feeding. 4th ed.

Bull. No. 7, *Minist. Agric.* 1936. (H.M.S.O., London, Price 1/- net).

A treatise on poultry nutrition and its basic principles, for the use of students and progressive poultry farmers.

477* HALNAN, E. T.

Scientific Problems of the Poultry Industry. III. Some Aspects of Poultry-Nutrition.

Emp. J. Exp. Agric. 1937, **5,** 38–42.

This paper contains the substance of an address given to the British Association in 1936, and indicates the direction in which the author considers research workers in Poultry Nutrition could most usefully serve the needs of the Industry. The limited extent to which a study of the relation of nutrition to disease is likely to yield fruitful results is also indicated.

HALNAN, E. T.

Search for Cheaper Poultry Foods.

Feath. World. 1937, **96,** 85.

A popular article, but containing a new method of calculating and assessing the relative cheapness or dearness of poultry foods.

HALNAN, E. T.

World's Poultry Congress.

Harper Adams Util. Poult. J. 1936, **21,** 545–548.

Summary of the contents of papers on poultry nutrition presented at the 6th World's Poultry Congress, 1936.

475* HALNAN, E. T. and FERMOR, C. E.

Table Meat Production.

U.S. Egg & Poult. Mag. 1937, **42,** 100–105.

An analytical study of the nutritive value of table meat birds of the Light Sussex—Rhode Island Red cross, at different killing weights. The following conclusions were reached :—

The results of an analysis of groups of cockerels and pullets of a Light Sussex Rhode Island Red cross of varying liveweights were reported.

A high percentage of the dressed carcass and edible offal consists of edible material.

The 3½ pound cockerel yields more edible material per pound of liveweight than any of the other liveweights studied.

The 5 pound cockerel gives the best yield of liveweight in proportion to the amount of food consumed.

Cockerels give better liveweight yields in proportion to the food consumed than do pullets, except in the case of birds of 2½ pound liveweight.

Cockerels of 3½ and 4 pounds, and pullets of 3½ pounds yield a higher proportion of edible protein in relation to food consumed than any of the other weights studied.

Cockerels of 3½ pounds and pullets of 4 pounds yield a higher proportion of edible energy in relation to food consumed than any of the other weights studied.

Poultry meat serves as an important source of supply of sodium, potassium, and sulphur, and to a lesser extent chlorine, but is relatively unimportant as a source of supply of calcium to human dietaries.

WOODMAN, H. E.
The Nutritional Aspects of Grass-Drying.
4th Int. Grassland Congr. Aberystwyth, July, 1937.

WOODMAN, H. E.
The Use of Oil Cakes and Extracted Meals. 2nd ed.
Bull. No. 11. *Minist. Agric.* 1937. (H.M.S.O., London. Price 9*d.* net.)

502* WOODMAN, H. E. and EVANS, R. E.
The Composition and Digestibility, when Fed to Pigs, of Three Grades of Meat Meal of Widely Differing Fat Content.
J. Agric. Sci. 1937, **27,** 465–473.

The composition, both organic and mineral, and the digestibility of three grades of meat meal of widely differing fat content were investigated. Large White hogs were used in the digestion trials. The methods of manufacture of the meat meals are described. They contained, on the basis of dry matter, 18·8, 11·1 and 3·2 per cent. of fat respectively.

All three grades had a very high digestibility. The digestion coefficient of the main constituent, namely, the crude protein, ranged from 87·9 per cent. in grade C (low fat) to 93·9 per cent. in grade B (medium fat), these values comparing satisfactorily with the corresponding value for white fish meal, namely, 90·2 per cent. The pigs digested the fat of the meat meals very efficiently. The fat of the grade A meat meal, forming 18·8 per cent. of the dry matter, was digested to the extend of 95·4 per cent.

The grade B meat meal (medium fat) was the most digestible of the three grades tested. This is the grade that is marketed for feeding to livestock. The slightly lower digestibility of grade A (high fat) is attributed to the influence of the high fat content in causing a slight lowering of the extent to which the crude protein is digested.

The grade C meat meal (low fat) was produced from the grade B by " de-greasing" with petroleum benzine at 300°F. The results suggest that this process may result in a distinct lowering of the digestibility of the meal.

451* WOODMAN, H. E., EVANS, R. E., CALLOW, E. H. and WISHART, J.
The Nutrition of the Bacon Pig. I. The Influence of High Levels of Protein Intake on Growth, Conformation and Quality in the Bacon Pig.
J. Agric. Sci. 1936, **26,** 456–619.

It was shown that a feeding treatment providing 12 per cent. of fish meal from weaning to 90 lb. live weight, 10 per cent. of fish meal from 90 to 150 lb. and 5 per cent. of a mixture of equal parts of meat meal and ext. soya bean meal in the final period supplied all the digestible protein required by Large White bacon pigs for the maximum rate of growth permitted by the net energy content of the ration. An increase in the protein supply beyond these levels did not lead to an increased rate

of live weight increase, not even in the period from weaning to 90 lb. live weight, when the influence of extra protein in improving the rate of growth might have been expected to be most clearly manifested. Indeed, an increase in the percentage of protein-rich food to an abnormally high level (32 per cent. in the weaners' ration falling to 25 per cent. in the finishing ration) caused a small though significant depression in the rate of live weight increase and a slight increase in the amount of meal required per lb. live weight increase, this being particularly noticeable in the period from 90 to 150 lb. live weight.

Statistical analysis of the results of the individual-feeding trial demonstrated the significance of the slight drop in rate of live weight increase in passing from the normal diet to one abnormally rich in protein. The individual-feeding lay-out adopted in the present trial enabled the comparison of the three feeding treatments to be carried out with an accuracy comparable with that associated with modern replicated experiments in agricultural crops. The group-feeding trial, carried out side by side with the individual-feeding trial, gave results affording general support to the findings of the individual-feeding experiment. Owing to the relative insensitivity of the group-feeding layout, however, it was not possible to show that the effects of the different feeding treatments were statistically significant. Despite this lack of sensitiveness, it is suggested that the ideal experimental lay-out is one that submits a given problem to investigation by the group-feeding technique side-by-side with the individual-feeding method. The group-feeding trial is the link between practical feeding and scientific experimentation and is to be regarded as a verification under practical conditions of the results of the individual-feeding trial.

The extremely wide variations in feeding treatment, involving a far-reaching replacement of cereal by protein-rich food, were without significant effect on the thickness of the back fat and belly streak. Neither did the feeding of the high protein rations lead to the production of leaner carcasses, as judged on the basis of back fat and the percentages of fat and lean in three typical rashers from the belly, back and gammon. The character of the feeding was also without significant influence on (*a*) the size of the " eye " muscle and the extent of fat infiltration into the area within the line of connective tissue ; (*b*) the length of the pigs as measured from the front rib to the pubis symphysis ; (*c*) the carcass percentages ; (*d*) the weight of the flares. The highest-protein-containing ration led to a significant increase in the weight of the kidneys, which, however, had a perfectly normal and healthy appearance. It is concluded, however, that there is no danger of kidney hypertrophy in pigs subsisting on the usual rations employed in pig-feeding.

479* Woodman, H. E., Evans, R. E. and Eden, A.

Sheep Nutrition. I. Measurements of the Appetites of Sheep on Typical Winter Rations, together with a Critical Study of the Sheep-Feeding Standards.

J. Agric. Sci. 1937, **27**, 191–211.

Feeding trials with sheep, subsisting out-of-doors on typical winter rations of known dry matter and starch equivalent content, were carried out during the winters of 1933–4, 1934–5 and 1935–6. Records were kept over these periods of the live weights of the animals and their daily consumption of dry matter and starch equivalent.

It was found that the standards of appetite, in terms of lb. dry matter, proposed by Prof. T. B. Wood, are uniformly too high. It is suggested that the old standards of appetite should be multiplied throughout by the factor 0·85 in order to obtain reasonable measures of the appetites of sheep at different live weights.

The data from the feeding trials were used in an attempt to decide between the old and the recently-proposed standards for the maintenance starch equivalent requirement of the 100 lb. sheep, namely, 0·74 and 1·26 lb. of starch equivalent per day. The results point to the reliability of the higher figure, and it is shown that the results of recent work on the energy metabolism of sheep are in harmony with this conclusion.

A table embodying a revision of Prof. Wood's feeding standards for sheep is included in the paper.

479* WOODMAN, H. E., EVANS, R. E., and EDEN, A.
Sheep Nutrition. II. Determinations of the Amounts of Grass Consumed by Sheep on Pasturage of Varying Quality.
J. Agric. Sci. 1937, **27**, 212–223.

A technique for measuring the appetites of sheep on pasture is described.

Results are given to show that sheep consume a bigger ration in terms of lb. dry matter when on pasture than when subsisting out-of-doors on the winter type of diet composed of hay, swedes (or kale) and concentrates. This difference was noted even on grass that had deteriorated in quality, in one case as a result of hot, dry weather in early summer, and in a second case as a consequence of cold, dry weather in spring. With young, leafy pasturage at its best, however, the distinction is most marked. The increased appetite is to be attributed to the superior palatability of the young grass.

OTHER PAPERS.

CRUICKSHANK, E. M.
The Value of Cod Liver Oil for Poultry.
21*st Annu. Poult. Conf.* Aug. 1937.
Harper Adams Util. Poult. J. 1937, **22**, 480-486.
also *Refresher Course for Poult. Instr.* July 1937. Harper Adams Agric. Coll.

GARNER, F. H.
Beet Pulp in Bullock Feeding.
Fmr & Stk-Breed. 1936, **50**, 2857.

GARNER, F. H.
Dried Sugar Beet Pulp for Fattening Cattle.
Sugar Beet Annu. 1937, pp. 71–83.

GARNER, F. H.
Reducing Cow-feeding Costs.
Fmr & Stk-Breed. 1936, **50**, 2685.

GARNER, F. H.
Stint the Heifer, Stunt the Cow.
Fmr & Stk-Breed. 1937, **51**, 392.

GARNER, F. H. and SANDERS, H. G.
Feeding for Butter Fat.
Fmr & Stk-Breed. 1936, **50,** 2799.

GARNER, F. H. and SANDERS, H. G.
How much Water do Sows Drink ?
Fmr & Stk-Breed. 1937, **51,** 1783.

HALNAN, E. T.
Feeding Dari in Place of Wheat.
Feath. World. 1937, **96,** 115.

HALNAN, E. T.
Is Feeding at Fault ?
Fmr & Stk-Breed. 1937, **51,** 289–290.

HALNAN, E. T.
Mineral Supplements in Chick Feeding.
Feath. World. 1937, **96,** 427.

HALNAN, E. T.
Recent Advances in Nutrition.
Refresher Course for Poult. Instr., Harper Adams Agric. Coll. July, 1937.

HANLEY, F.
Maize and its By-Products.
Husbandry. 1937, **7,** 85–87.

HANLEY, F.
Uncommon Feeding Stuffs.
Husbandry. 1936, **7,** 6–9, 47–48.

ANIMAL PHYSIOLOGY.

505* DEIGHTON, T.
A Study of the Fasting Metabolism of Various Breeds of Hog. III. Metabolism and Surface Area Measurements.
J. Agric. Sci. 1937, **27,** 317–331.

From metabolism experiments carried out on the pigs enumerated in the first paper of this series† the following conclusions are drawn :

(*a*) The metabolism in a state of inanition appears to be more a function of a power of the weight than of the true surface area as determined by the photographic method.

(*b*) Hogs born in the summer and autumn of one year appear to show two maxima of metabolism ; one almost immediately, as has been observed previously, and another during the following summer, provisionally ascribed to the effect of light on thyroid activity, produced by the intermediary action of the anterior pituitary.

(*c*) Actual, and theoretically computed average growths are shown to agree remarkably well in the case of eleven of the pigs which were treated in an exactly similar manner. Individual growth curves showed no such agreement. This is considered to strengthen the evidence for the writer's previously stated view that net energy is a statistical rather than a physiological constant.

† J. Agric. Sci. 1934, **24,** 326. (Memoir 6, p. 24).

508* HAMMOND, J.

Forholdene mellem Forplantningens Fysiologi og Maelkeskretionen.

Nord. JordbrForskn. 1937, *Hefte.* 3–4A, 81–85.

A summarized account dealing with the development of the mammary gland during foetal life : the stages in the development after birth in the rabbit and the cow, together with the causes for these changes ; the lactation curve and the factors which affect it : and the process of milk secretion, including the effects of milk pressure in the udder and the " letting down " of milk.

486* HAMMOND, J.

Pregnancy and Nutrition of the Embryo in the Rabbit.

Sch. Sci. Rev. 1937 (No. 72), pp. 548–557.

A brief account of fertilization and the changes occurring in the reproductive organs of the rabbit during pregnancy.

462* MARSHALL, F. H. A.

Sexual Periodicity and the Causes which Determine it.

Philos. Trans. ' B '. 1936, **226,** 423–456.

The author points out that there is in the higher as in the lower animals an inherent reproductive rhythm and that this rhythm may be influenced in its periodicity by external factors. The inherent reproductive rhythm is shown to be determined by the gonads acting through the hormones elaborated by them, the gonads in turn being influenced in their activity by the hormone or hormones secreted by the anterior pituitary. The extent to which these gonadotropic activities of the anterior pituitary are regulated by exteroceptive or external stimuli is then critically surveyed, and the general conclusion is reached that the principal stimulus responsible for the seasonal changes in breeding phenomena among animals is light, the stimuli received by the eyes or other photoreceptors being transmitted by nervous paths to the anterior pituitary. The other exteroceptive stimuli, such as coition, suckling, and courtship phenomena, are shown to be effective in certain animals in controlling or modifying the phases of the sexual cycle and likewise appear to operate through the nervous system, probably the hypothalamus or the anterior pituitary and thence upon the testes and the ovary.

It is concluded that in all the higher animals sexual periodicity, while conditioned by the environment, is regulated in its successive phases by the combined integrative action of the nervous and endocrine systems.

The primary periodicity is a function of the gonad, the anterior pituitary acting as a regulator, and the internal rhythm is adjusted to the environment by the latter acting on the pituitary, partly or entirely, through the intermediation of the nervous system.

454* MARSHALL, F. H. A and BOWDEN, F. P.

The Further Effects of Irradiation on the Oestrous Cycle of the Ferret.

J. Exp. Biol. 1936, **13,** 383–386.

The investigation of the effect of radiation on the oestrous cycle of the female ferret has been continued.

Earlier experiments with the ultra-violet light have been repeated and confirmed. Irradiation with light of λ3650Å. caused the ferrets to come on heat early and to remain on heat for an abnormally long time after irradiation had ceased.

Heat rays of long wave-lengths caused no acceleration. This is in accordance with earlier experiments which showed that heat rays and infra-red (λ7500Å.) had little effect.

Two pairs of ferrets were subjected to the same total quantity of radiation from incandescent lamps, but in one case it was concentrated into 2 hours, and in the other spread over 16 hours. There was little difference in the behaviour of the two pairs and both showed an acceleration of oestrus.

ANIMAL PRODUCTION.

491* Dunlop, G. and Hammond, J.

The Growth and Proportions of the Rabbits Ear in Relation to Body Weight.

J. Genet. 1937, **34,** 463–475.

As a preliminary basis for a study of body proportions in farm animals, measurements of ear length and body weight were taken in rabbits as the animals grew up. Inbred strains of rabbits were used and crosses and back-crosses between two of these were investigated.

Ear length is an early maturing part of the body and attains its maximum rate of growth (mm. per week gained) much earlier than that of body weight (g. per week gained) which is a late developing part. In a small breed the rate of maturity of body weight (maximum rate of growth) is speeded up as compared with a large breed.

The ratio $\frac{\text{Body weight (g.)}}{\text{Ear length (mm).}}$ was used to express the changes in body proportions. Changes in the proportions of the body occur with weight rather than with age as such. A large strain has a larger proportional development of the late maturing parts than has a small strain when compared at the same age, but when compared at the same weight the small strain has a larger proportional development of the late maturing parts than a large strain.

Within the same strain, animals which are relatively small when they are young but are relatively large when old have, as compared with those in which conditions are reversed (cross-over growth curves), a larger proportional development of the late maturing parts of the body.

In general, the proportions of the body tend to be intermediate in inheritance but are, especially in the early stages, much affected by the amount of nutrition (milk) received from the dam.

442* Davidson, H. R., Hammond, J., Swain, J. B. and Wright, N. L.

Method for Judging Pork and Bacon Carcases.

N.Z. J. Agric. 1937, **54,** 203–215.

Reprint of article which appeared in the *Pig Breed. Annu.* 1936–37, **16,** 49–64, and summarized in *Memoir* 8, p. 31.

452* EDWARDS, J.

The Effect of Breed, Size of Cow, Yield of Milk and Stage of Lactation upon Efficiency of Milk Production.

J. Dairy Res. 1936, **7**, 211–221.

The records of 2400 cows on test at the London Dairy Show between the years 1922 and 1934 are examined for the relationship between the gross physiological efficiency of milk production and the factors of breed, size of cow within a breed, actual yield of milk and stage of lactation. (" Gross Efficiency " is here the ratio of energy in the milk to the energy in the digestible nutrients consumed.)

It is shown that among the best representatives of the various dairy breeds there is little difference in gross efficiency of milk production. The lactation stimulus has been bred approximately in proportion to the size of the breed.

Cows, in spite of their greater weight, are more efficient than heifers, and animals milked thrice daily than those milked twice daily.

Within the breed there is a slight though definite tendency for gross efficiency to decrease with increase in live weight.

Greater than any of the foregoing differences in gross efficiency is that which exists within a breed due to differences in actual milk yield.

Stage of lactation has also much to do with gross efficiency. There is a steady decline in efficiency with advance in lactation from 38·75 to 29·25 per cent.

ANIMAL PRODUCTION.

487* HAMMOND, J.

Om Kødkvaliteten hos Faar og Kvaeg.

Nord. JordbrForskn. 1937, Hefte 1–2, 24–37.

The various factors which go to make up quality in lamb, mutton and beef are briefly described.

497* HAMMOND, J.

Pigs in the Argentine.

Pig Breed. Annu. 1937–38, **17**, 28–32.

Impressions of various aspects of the pig industry in the Argentine obtained during a short stay there in September, 1936.

474* HAMMOND, J.

La Produccion de Carne y los experimentos en materia de alimentacion.

Sociedad Rural Argentina, 23 Sept. 1936 : and *La Res.* 4 (No. 66), 5 Oct. 1936.

A short account of the general principles of feeding for meat production in cattle, sheep and pigs with special reference to conditions in the Argentine.

493* HAMMOND, J.

The Shape of the *longissimus dorsi* Muscle in Domestic Animals.

Neue Forschungen in Tierzucht u. Abstammungslehre : Festschrift Prof. U. Duerst, Bern, 1936, pp. 92–97.

This paper shows, with illustrations for sheep and cattle, how the shape of a muscle—the *longissimus dorsi*, one of the most valuable ones in the carcase—changes as breeds of domestic animals become specialized for meat producing purposes; and how these changes are but an extension of the normal processes of the muscle.

501* Hammond, J. and Murray, G. N.

The Body Proportions of Different Breeds of Bacon Pigs.

J. Agric. Sci. 1937, **27**, 394–431.

Weights and measurements of sides of bacon made under standard conditions from different breeds and crosses of pigs and exhibited at the London Dairy Show from 1922–31 have been analysed statistically.

The actual live weight of the pig affects the carcass percentage more than does breed or type.

For a bacon pig of 200 lb. live weight, there is an optimum carcass percentage (about 79 per cent.) and an optimum bacon percentage (about 58 per cent.). The highest percentage is not necessarily best, for below about this level the proportion of bone will be too large and above this level the proportion of fat will be too large.

The reasons why certain measurements and proportions are necessary to meet market requirements are detailed.

The changes in the proportions of the side with increase in weight of the side are described. The proportional increase in bacon weight is much greater than the proportional increase in side length. Both belly thickness and thickness of shoulder fat increase in their proportions at a faster rate than side length, but not so fast as side weight. The thickness of fat over the loin is the only part measured that increases at a faster rate than side weight.

The subcutaneous layer of fat matures earliest at the shoulder, over the rump next, and on the loin last. The rate of increase of the back fat slows down as the sides increase in weight. This slackening of growth is greatest in the shoulder and least in the loin, the rump area being intermediate.

The ratio between the thickness of fat at the shoulder and at the loin decreases as the weight of the side increases. In early-maturing pork breeds the ratio decreases quicker than in the late-maturing breeds.

Since the region of the last rib is the latest maturing part of the body, it is at this place that the carcass should be cut in order to obtain a proper estimate of its development.

A comparison is made of the relative side weight, side length, back-fat and belly thicknesses of different breeds at constant side weight and at constant side length.

When first crosses between two pure breeds are compared at similar weights there is an indication that, while back fat and belly thickness are intermediate, the body length is slightly above the mean of the parent breeds.

For each unit of increase in side length the pork type increases much more in side weight than the bacon type.

As the side is lengthened at constant side weight, so the thickness of the back fat is decreased, while there is no constant effect on belly thickness.

At equal side lengths the sow has a thicker belly and thinner back fat than the castrated boar pig.

Castration in either sex increases the thickness of the back fat, while in sows it also decreases belly thickness.

MENZIES-KITCHIN, A. W.

Pre-weaning and Post-weaning Mortality in Pig Production.

Fm Econ. 1937, **2,** 126–129.

This is a note on an investigation of the mortality in 1270 litters totalling 12,110 pigs born alive. The analysis of the amount and causes of mortality is grouped by pre-weaning and post-weaning periods. Pre-weaning deaths amounted to 18.5 per cent. of pigs born alive, the most common cause of loss being " overlaid by sow." Post-weaning mortality averages 3 per cent. of pigs weaned. Thus approximately one out of every five pigs born alive failed to reach maturity.

OTHER PAPERS.

455* EDWARDS, J.

Facts about Milking.

Fmr & Stk-Breed. 1936, **50,** 2506.

GARNER, F. H.

Milk Recording and Grading.

Dairy Shorthorn J. 1936, **5,** 534–539.

Repr. in *Cambs. Milk. Rec. Soc. Yearb.* 1937, pp. 52–55.

HAMMOND, J.

Factors which Influence Mutton Prices.

Fmrs' Wkly. 1937, **7** (No. 2), 25.

HAMMOND, J.

What I saw of the Beef Industry in the Argentine.

Fmrs' Wkly. 1936, **5** (23), 15.

MENZIES-KITCHIN, A. W.

Why not Stock Sows before Weaning?

Fmrs' Wkly. 1937, **6** (No. 13), 47.

FORESTRY.

453* THOMPSON, C. H.

Home Grown Timber. Some Considerations on Policy.

Quart. J. For. 1936, **30,** 275–288.

Traces the post-war developments affecting the Home Grown Timber Industry and summarizes the position reached in 1935. Emphasis is laid on the difficulties confronting the industry and the poor condition of the majority of privately-owned woodlands in England and Wales. Records the comparative failure of the Forestry Commission's Planting Grants Scheme, and suggests in substitution an annual acreage grant for all woodlands, worked on a simple management plan covering filling, replanting and thinning.

PLANT BREEDING AND GENETICS.

485* BELL, G. D. H.

The Art and Science of Plant Breeding.

Agric. Progr. 1937, **14,** 126–135.

A summary of a paper read at the Agricultural Education Association meeting in December 1936. The paper deals very briefly, and in a semi-popular manner, with the present position of plant breeding in relation to modern scientific development,

particularly those of genetics and cytology. A short account in given of the degree to which the application of these sciences has been practicable and successful in the improvement of agricultural plants. It is concluded that plant breeding has only been able to incorporate scientific precepts, to a very limited extent, and as such may still be largely regarded as an art.

Bell, G. D. H.
Crops and Plant Breeding.
Fmrs' Guide Agric. Res. 1935.
J. Roy. Agric. Soc. 1936, **97,** 151–185.

The first section of this review deals with current research work on grassland with particular reference to the behaviour of species and strains in field trials, the effect of grazing and manuring on the botanical composition of grassland, and the improvement of poor pastures. This is followed by two short sections dealing with weed eradication and the artificial control of plant development respectively. The discussion on weed eradication is confined to the use of chemicals for the eradication of perennial weeds, and to the results so far obtained in methods of biological control of weeds. The artificial control of plant development deals mostly with the practical application of vernalization to agriculture.

The fourth section is devoted to wheat research, and accounts of recent work on quality, diseases and other less important aspects are given. Reference is made to the new variety Holdfast, and much of the pathologic subject matter describes the factors affecting the incidence of root-rot.

The review concludes with accounts of variety trials with spring and winter oats.

495* Hudson, P. S.
Genetics in its Application to Plant Breeding.
Biol. Rev. 1937, **12,** 285–319.

The importance of Mendelism in relation to practical breeding problems is illustrated by reference to early work on the inheritance of economic characters.

Examples are given of improved varieties that have been produced by individual plant selection. The possibilities of success are shown to be dictated by the completeness of the material and one of the essentials for successful breeding is shown to be the collection of adequate and representative stocks of initial breeding material. This is illustrated largely by reference to Russian work, which has also elucidated the laws governing the distribution of plant varieties, characters and genes.

The possibilities of putting interspecific or distant crosses to practical use are analysed and cases where this has been done are cited. Chromosome duplication is shown to be a frequent phenomenon in such cases and to be a factor greatly increasing the economic value of such distant crosses. Numerous cases are quoted and the phenomenon is shown to have played an important rôle in the origin of new species and forms in nature. Its experimental control is thus of great practical value.

The origin of new forms of pathogenic fungi by hybridization and mutation is illustrated and shown to be a serious obstacle in breeding for disease resistance.

Examples are given where the obstacle has been overcome by breeding methods and other cases are mentioned where the problem of disease resistance remains unsolved.

The rôle of mutations in the origin of new forms of agricultural plants is discussed and the possibilities of effecting this process artificially are analysed.

The phenomenon of vernalization is described, with special reference to breeding. The significance of this and other recent physiological studies in producing forms possessed of earlier maturity is discussed.

The nature of plant yield is discussed and reference is made to attempts to analyse and regulate this by genetical methods.

492* HUNTER, H.

Some Aspects of Malting-Barley Breeding in Great Britain.

C.R. V^e Congr. Int. Techn. Chim. Industr. Agric. Schéveningue, 1937 (Sect. 4), pp. 291–309.

The author gives an account of the demonstration of the high yield and good malting quality of Archer (*Hordeum distichum nutans*) in tests carried out in Ireland beginning about 1900. A Danish selection of Archer was grown on the continent under the name Prentice. The superiority of this selection led to single plant selections being made in Ireland and one of these, Irish Archer No. 1, was crossed with Spratt (*H. distichum zeocrithum*) to produce the famous variety Spratt-Archer. The new variety is earlier than Archer, less liable to lodging and yields more grain of slightly higher malting quality.

An outstanding feature of Spratt-Archer is its high tiller survival and the author presents some experimental data indicating that this character is associated with high yield and good malting quality. Nitrogenous fertilizer applied at an early stage in the life of a barley plant causes an increase in tillering and of yield of grain without increasing the nitrogen content (and therefore decreasing the malting quality) of the grain. The same fertilizer, however, applied at a late stage causes little or no increase in tillering but a marked increase in nitrogen content of the grain. Again, artificial removal of tillers causes an increase in nitrogen content and in thousand-grain weight. The author suggests therefore that in varieties of the Archer and Spratt-Archer type the plant breeder's search should be directed towards lines of high tiller survival to obtain high yield and good malting quality.

Recent re-selection experiments with Spratt-Archer have indicated that the variety is not a pure line in the strict sense of the term but is an assemblage of lines differing in physiological characters such as earliness. One of the earlier lines selected has proved to be more prolific and of higher malting quality than any of its competitors. The author suggests that an assemblage of pure lines may make a more useful variety than one pure line, owing to the wider adaptability of the former.

While low nitrogen content is a good general indication of high malting quality, the correlation is not absolute and one of the sister lines of the original Spratt-Archer had a lower nitrogen content than Archer but a lower malting quality than that parent.

The variety Plumage-Archer was bred by Dr. Beaven from the cross between Plumage (*H. distichum erectum*) and Archer, to combine the good malting qualities of Goldthorpe (also *H. distichum erectum*) with the low loss of ears characteristic of Archer. Plumage-Archer is equal to Spratt-Archer in yield and malting quality. There is

evidence that Plumage-Archer does not show as high a tiller survival as Spratt-Archer, but has a higher ear weight, which is sufficient, in conjunction with medium to high tillering capacity, to secure low total nitrogen. There are also indications that varieties of the *erectum* group give a somewhat higher extract than those of the *nutans* group under conditions of equal total nitrogen content. Plumage-Archer is more widely grown in England, Spratt-Archer in Ireland.

498* Morris, L. E.

Pollen Germination in *Brassica chinensis* × *Raphanus sativus* F_1 Hybrids.

J. Genet. 1936, **33,** 435–441.

Diploid pollen, with 19 chromosomes, from the F_1 hybrid plants ($2n = 19$) of *B. chinensis* × *R. sativus* usually failed to grow on the F_1 stigmas. It was however, fully capable of germination on the stigmas of swede ($2n = 36$) and of some other crosses. Also pollen of radish, *B. chinensis*, and swede was able to grow on the F_1 stigmas.

The sterility of the F_1 plants is attributed to the alteration of the chromosome balance between pollen and style from the usual $1n : 2n$ to $2n : 2n$.

483* Morris, L. E. and Richharia, R. H.

A Triploid Radish × Turnip Hybrid and Some of its Progeny.

J. Genet. 1937, **34,** 275–286.

Pollinating radish ($n = 9$) by turnip ($n = 10$) gave, amongst other plants, a triploid hybrid with $2n = 28$; probably from a diploid radish egg-cell.

By open pollination the triploid hybrid gave a varied progeny including two hexaploid plants with $2n = 56$. These resembled the triploid, but some had 9 chromosomes, and were genetically similar to those of radish.

The pollen of the triploid, like the egg-cells, showed a wide range from 9 chromosomes probably up to triploid. Used on radish, however, it was chiefly that with 9 chromosomes, similar to those of radish, that gave progeny, though some 10 chromosome pollen also was functional. Thus, apparently, triploid pollen was functional on the triploid but not on radish, probably owing to the chromosome ratio between pollen and stigma.

From the back-cross to radish a plant with a single extra turnip chromosome appeared to be identical with radish except for its reduced fertility.

Richharia, R. H.

Cytological Investigation of *Raphanus sativus*, *Brassica oleracea*, and their F_1 and F_2 Hybrids.

J. Genet. 1937, **34,** 19–44.

Among the somatic chromosomes of *B. oleracea* (Brussels sprout) six or seven types are distinguished. At diakinesis three varieties, viz. Brussels sprout, curly kale and cabbage, were examined. In the first two, nine bivalents are regularly observed. In cabbage a ring or chain of four chromosomes is formed. Secondary pairing is studied in curly kale, the maximum number of associations being five.

Among the somatic chromosomes of *R. sativus* six types are distinguished. At diakinesis regularly nine bivalents are formed. The maximum number of secondary associations is four.

The F_1 between *R. sativus* × *B. oleracea* was followed from late diplotene onward, and at this stage there is a variable amount of pairing, in extreme cases six bivalents being observed. At metaphase secondary pairing among the univalents is distinctly seen.

Of twenty-one F_2 hybrids about half were hypotetraploids. Trivalents and tetravalents were quite frequently formed. Multivalents are rarely seen in the parents. It is therefore very probable that some, at least, of the bivalents in F_1 come from pairing of *Raphanus sativus* with *Brassica oleracea* chromosomes.

The maximum number of secondary associations among bivalents examined from two F_2 tetraploids and two F_2 hypotetraploids ($2n = 34$), was twelve. Since the maximum number of associations in the two parents added together is only nine, this suggests that some of the associations in F_2 are between the chromosomes of different parents.

In other crosses involving *R. sativus* with *B. chinensis* ($2n = 29$), *B. rapa* ($2n = 20$) and *B. carinata* ($2n = 34$), in extreme cases eight, seven and nine bivalents were observed.

RICHHARIA, R. H.

Cytological Investigation of 10-Chromosome Species of *Brassica* and their F_1 Hybrids ''.

J. Genet. 1937, **34**, 45–55.

This paper deals with three 10-chromosome species of *Brassica*, viz. *B. chinensis*, *B. rapa* and *B. pekinensis*, and their F_1 hybrids.

Among the somatic chromosomes six principle types are distinguished.

At diakinesis and metaphase in all the forms two types of bivalents can be distinguished, i.e. five large and five small, except in *B. rapa* where in some plates a transition is noticed at metaphase. In *B. chinensis* × *B. rapa* and *B. chinensis* × *B. pekinensis* meiosis was regular, but in the former fertility was not complete. In *B. pekinensis* × *B. rapa* occasionally two free univalents were observed and occasionally separation was into 9 and 11 instead of 10 and 10, but the reduction in pollen fertility was small and not necessarily significant.

A high amount of secondary association, together with the association between morphologically different chromosomes, strongly suggest chromosome rearrangements, besides reduplication. This makes it difficult to arrive at any definite conclusion with respect to the primary basic number.

OTHER PAPERS.

HUDSON, P. S.

The Imperial Bureau of Plant Genetics.

I.I.D. Comm. 1937, **4** (Fasc. 1), 5–7.

SALAMAN, R. N.

Report of the Potato Synonym Committee, 1935 and 1936.

J. Nat. Inst. Agric. Bot. 1937, **4**, 158–162, 163–167.

PLANT PATHOLOGY.

466* Brett, C. C., Weston, W. A. R. Dillon and Booer, J. R.
Seed Disinfection. III. Experiments on the Germination of Peas. Seed Protection by the Use of Disinfectant Dusts Containing Mercury.
J. Agric. Sci. 1937, **27,** 53–66.

The evidence produced by these experiments indicates that for sowings earlier than March, when encountered, the application of a suitable organic mercury compound in the form of a dust is likely to result in an increased stand and yield of marketable pods. For sowings later than this there is evidence that the advantages of the application of such a dressing are doubtful. There is a suggestion too, that the soil to laboratory germination ratio tends to increase as the date of sowing advances, and may be in the region of 60-65 per cent. for sowings in March and April.

The greenhouse and small-scale field trials produced data to support the view that probably the chief value in the application of an organic mercury compound to peas lies in its protective action.

Dowson, W. J., and Weston, W. A. R. Dillon
Brown Rot of the Hawthorn.
Gdnrs Chron. 1937, **101,** 426.

An account is given of the prevalence in East Anglia in 1937 of a brown rot disease of Hawthorn caused by the Monilia stage of the fungus *Sclerotinia Crataegi.*

Salaman, R. N.
Acquired Immunity Against the ' Y ' Potato Virus.
Nature. 1937, **139,** 924–925.

Description of the methods employed in obtaining strains of reduced virulence of this virus, and their possible use as a vaccine.

481* Salaman, R. N.
Plant Viruses and Their Relation to Those Affecting Man and Animal.
Lancet. April 3rd, 1937, pp. 827–833.

A resumé of our knowledge in regard to plant viruses in general, and their relation to such as affect man and animal.

507* Smith, K. M.
An Air-borne Plant Virus.
Nature. 1937, **139,** 370.

Experiment has shown that the root virus reaches the roots of tobacco plants growing in autoclaved soil and watered with boiled tap water. The virus has also been isolated from the air by means of a suction apparatus which draws the air through sterile wool plugs. These facts are considered sufficient to indicate the ability of this virus to reach the soil via the air and thence to make its way into the roots of susceptible plants.

471* Smith, K. M.

Further Studies on a Virus Found in the Roots of Certain Normal-looking Plants.

Parasitology. 1937, **29**, 86–95.

Further experiments have shown that the root virus described above reaches the soil in the water whence it eventually arrives in the roots of the plant. The possibility of the virus being carried in the air must still be considered. Some of the physical properties of the virus have been determined. It is extremely resistant and is still infectious after 6 months in absolute alcohol. It withstands complete desiccation and is of very small size, between 20–30 millicrons in diameter.

470* Smith, K. M.

Studies on a Virus Found in the Roots of Certain Normal-looking Plants.

Parasitology. 1937, **29**, 70–85.

A virus has been isolated from the roots of a number of different species of plants such as tobacco, tomato, aster, zonal pelargonium, *Primula obconica, Polyanthus* and *Phaseolus vulgaris*. It is only in tobacco and *N. glutinosa* that *natural* disease symptoms due to this virus have ever been observed. The fact that this virus spreads in the absence of insect vectors and even when the plants are grown in sterilized soil suggests that here is a new method of spread for a plant virus.

465* Weston, W. A. R. Dillon, Hanley, F. and Booer, J. R.

Seed Disinfection. II. Large-scale Field Trials on the Disinfection of Seed Corn with Mercury Dust Disinfectants.

J. Agric. Sci. 1937, **27**, 43–52.

Treatment in bulk of the grain of wheat, barley, winter oats and spring oats with a proprietary dust, and two experimental dusts A and B which contained organic compounds of mercury, had no harmful effect on germination when drilling followed shortly after treatment. In the case of spring oats, drilling was delayed 7½ weeks after treatment without any harmful effects on germination.

The proprietary and experimental dusts both proved effective in controlling bunt disease of wheat, and the leaf-stripe and net-blotch diseases of barley.

In the case of barley, the proprietary and experimental dusts both increased the speed of " brairding " but not the final plant population. This hastening of seedling growth did not lead to a higher yield.

In the case of winter oats, only the experimental dust A gave a significant increase in plant population and a satisfactory control of the loose smut disease.

Both the proprietary dust and the experimental dust B gave a significant increase in plant population in spring oats, and both gave a satisfactory control of the leaf-spot disease.

The results suggest that different organic mercury compounds do not affect the speed of " brairding " of all cereals to the same extent ; and a dust which controls

certain seed-borne diseases, such as leaf spot of oats and bunt of wheat, will not necessarily control all seed-borne diseases, e.g. loose smut of oats. In selecting a disinfectant dust it is therefore desirable to know what forms of seed-borne disease it will control.

The poisonous, vesicant and other properties of the experimental dusts A and B are noted and it is stated that efficient precautions must be taken if they are used for experimentation.

OTHER PAPERS.

SMITH, K. M.
Detecting the Invisible ; How Some Plant Diseases are Investigated.
Listener. 1936, **16,** 764–766.

PLANT PHYSIOLOGY.

496* BARNELL, H. R.
Analytic Studies in Plant Respiration VII. Aerobic Respiration in Barley Seedlings and its Relation to Growth and Carbohydrate Supply.
Proc. Roy. Soc. London ' B '. 1937, **123,** 321–342.

Certain aspects of the respiration process in young barley (Spratt-Archer) seedlings, of their isolated endosperms and of their isolated embryos have been studied. Data connecting the respiration and growth rates have also been obtained and an attempt made to describe the development of contemporaneous activities in both parts of the embryo-endosperm system.

The true course of the respiration rate for whole seedlings has an initial slowly rising phase followed by a middle phase of steady increase and finally an upper limit during which the respiration rate fluctuates about a mean value for 100 or more hours.

Evidence is given of the living nature of endosperm cells of barley. Their respiration rate is approximately constant at 2 mgm. CO_2 per 3 hours per 100 endosperms and it is held that this rate is limited by the number of respiratory centres within the endosperm. The initial rapid fall in the respiration rate of isolated embryos and the small asymptotic rate attained indicate that their carbohydrate reserve is not large.

An approximate relationship between the respirative rate and growth (in dry weight) of the embryos is established such that 64 per cent. of the hexose entering from the endosperm in a given time is utilized in growth and 36 per cent. for respiration. A scheme is given showing the progress of the development of the processes of hydrolysis and respiration in the endosperm, the translocation of the non-respised products of hydrolysis into the embryo and their use in growth and respiration within the embryo. The factors limiting the rates of the processes at these variousstages of seedling growth are discussed.

503* BELL, G. D. H.
The Effect of Low-temperature Grain Pre-treatment on the Development, Yield and Grain of Some Varieties of Wheat and Barley.
J. Agric. Sci. 1937, **27,** 377–393.

Two winter varieties and one spring variety of barley and wheat were subjected to low-temperature grain pre-treatment, and the effects of this treatment were

investigated by data collected from two Latin Square trials. It was found that the winter varieties were affected very strongly in some of the characters studied, while the spring varieties showed little effect.

The characters affected by the treatment were tiller number, yield per plant, yield per tiller, 1000-grain weight and nitrogen percentage of the grain. All the varieties were not affected to the same extent.

Analysis of the varietal behaviour showed that maximum tiller number per plant bore little relationship to the number of ears per plant at harvest. The importance of ear survival in determining yield and grain quality is briefly discussed.

It is concluded that the low temperature treatment of winter and spring varieties has no economic value under the conditions of the experiment.

DENNIS, R. W. G.

The Relation of Boron to Plant Growth.

Sci. Progr. 1937, **32**, 58–69.

A summary of literature relating to the symptoms of boron deficiency in crop plants and the function of boron which appears to be related to the regulation of the water content of the plasma colloids. A short discussion is also given of the sources of boron in the soil and the origin of a state of boron deficiency in soils, with special reference to the effect of liming.

461* WOODMAN, R. M.

Pure Silica Sand as a Basis for Phosphate Deficiency Tests on Lettuce.

Sands, Clays & Min. 1936, **3**, 22–27.

A pure sand suitable for single element variations is described.

Seedlings of *May King* lettuce receiving media absolutely deficient in phosphate or consisting of phosphate solution alone were of a darker green colour than those receiving media with all the essential elements present.

In general, media from which phosphate was absent finally caused bronzing of the leaves of the resulting stunted plants, with red or crimson stalks. Phosphate alone produced characteristic purple and apple-green (sometimes bronze and apple green), flat, stunted plants with relatively broad, non-crinkly leaves, and with red stalks. Water alone caused stunted, straggly plants with relatively long crimson stalks.

Where phosphate was supplied in addition to other essential elements, a " normal " plant of green colour at first resulted ; later, purple blotches appeared on the plants receiving the least phosphate. The intensity of this purple was greater as the amount of phosphate in the medium diminished ; it could be controlled at will either by variation in the frequency of application of the media or in the concentration of the phosphate supplied.

A tougher leaf resulted from an inadequate supply of phosphate. Early maturity, as judged by hearting, was caused by a plentiful supply of phosphate.

488* Woodman, R. M. and Barnell, H. R.

The Connexion Between the Keeping Qualities of Commercial Varieties of Onions and the Rates of Water Loss During Storage.

Ann. Appl. Biol. 1937, **24,** 219–235.

From the results for the onion varieties examined it is demonstrated that high relative rates of water loss and high total water losses are characteristic of non-keeping types. This is especially so in the period immediately succeeding harvest, and the argument is therefore put forward that actual keeping tests are unnecessary when classifying, for example, new lines as keepers and non-keepers.

Wortley, W. R. S.

The Effect of Salts of Lithium on the Resistance of Certain Plants to Disease.

J. Roy. Agric. Soc. 1937, **97,** 492–498.

The observation of Spinks that the application of small quantities of lithium salts to the soil results in a marked decrease in the susceptibility of wheat to mildew (*Erysiphe graminis*, D.C.) has been confirmed.

The addition of 10 c.c. of a 5 per cent. solution of the nitrate, chloride or sulphate of lithium to the soil contained in 4 inch pots was found to give satisfactory results.

The susceptibility of lettuce to ring-spot (*Marssonina panattoniana*, Berl.) is also reduced by treatment with lithium salts, but negative results have been obtained with brown rust of wheat (*Puccinia triticina*, Erikss.)

A comparative cytological study of the infection by mildew of susceptible wheat and of wheat rendered partially immune by means of lithium has been undertaken. The varieties of wheat used were Red Marvel and Cambridge Rivet. The examination of epidermal strips taken from the lower surface of inoculated leaves and stained in lactophenol and cotton blue has led to the conclusion that the partial immunity conferred by lithium is due to an increase in the resistance to penetration by the fungus of the non-cuticular part of the outer epidermal cell-wall.

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Hudson, P. S.

Vernalization.

Ctry Life. 1936, **80,** 537–538.

SOILS AND MANURES.

450* Childs, E. C.

Transport of Water Through Heavy Clay Soils. III.

J. Agric. Sci. 1936, **26,** 527–545.

Using the methods described in Parts I and II† the hitherto unexplained results of various American workers have been shown to fit in quantitatively with the theory of diffusion of water in heavy soils.

† Memoir 8, p. 41.

NICHOLSON, H. H. and HANLEY, F.

The Soils of Cambridgeshire.

Bull. 98, *Minist. Agric. and Fish.*, 1936. (H.M.S.O., London. Price 4*s.* 2*d.* Post Free).

A general account of the soils of the county based on the geology and physiography of the area is given. On this basis each locality is described with details of the geological deposit or parent material, the mechanical and chemical analysis of typical samples, the soil profiles and the working and drainage properties of the soils. The connection between the properties of the soil and the methods of farming and manuring is indicated for each area. The inherent deficiencies of each soil type are discussed, together with methods of amelioration.

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GARNER, F. H. and SANDERS, H. G.

Manuring of Wheat with Artificial Nitrogen.

Husbandry. 1937, **7,** 48–50.

HANLEY, F.

Notes on Manuring.

J. Minist. Agric. 1936, **53,** 676–680, 802–807, 894–899, 985–989, 1092–1097, 1185–1190: **44,** 75–80, 170–175.

HANLEY, F.

The Soils of East Norfolk.

Norfolk Fruit Grower. 1937, pp. 87–89.

MANSFIELD, W. S.

Slag in Heavy-land Fertility.

Fmr & Stk-Breed. 1937, **51,** 2153.

MISCELLANEOUS.

472* MILES, A. A. and HALNAN, E. T.

A New Species of Micro-organism (*Proteus melanovogenes*) **Causing Black Rot in Eggs.**

J. Hyg. 1937, **37,** 79–97.

An organism is described as the specific cause of black rot in hens' eggs. The organism has been identified in English soils and manures. Such eggs on candling show liquid white and deep orange red yolks which rapidly turn to deep black. An offensive smell is readily noticeable in consignments containing infected eggs.

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Animal Nutrition Research Institute.

East Anglian Pig Recording Scheme. Reports, 1–3, 1929–30.
(*These Reports have been discontinued*).

To be obtained from The Secretary, School of Agriculture, Cambridge, ENGLAND. Price 1*s*. each.

Cambridge University Agricultural Society Magazine (Issued Annually. 3 numbers comprising a volume).

Vol. 1. (1924–26). Vol. 1. No. 1. 1924 *Out of Print*.
Vol. 2. (1927–29).
Vol. 3. (1930–1932).
Vol. 4. (1933–1935).
Vol. 5. (1936–1937).

To be obtained from The Editor, School of Agriculture, Cambridge, ENGLAND. Price, per number, 1925–1932, 1*s*. Post Free ; 1933–37, 2*s* 6*d*. net or 2*s*. 9*d*. Post Free.

Farm Economics Branch.

Farmers' Bulletin No. 1. " Interpretation of Farm Accounts." (*3rd Edition*.) Price 6*d*. Post Free.

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Report No. 3. " An Economic and Financial Analysis of Fifteen East Anglian Farms in 1924–25." (2*nd Edition*.) Price 1*s*. net. Postage 1*d*.

Report No. 4. " An Economic and Financial Analysis of Seven Eastern Counties Farms in 1925–26." (*Out of Print*.)

Report No. 5. " A Successful Norfolk Poultry Farm, 1922–26." (3*rd Edition*.) Price 1*s*. net. Postage 1*d*.

Report No. 6. " An Economic and Financial Analysis of Thirteen East Anglian Farms in 1925–26." Price 1*s*. net. Postage 1*d*.

Report No. 7. " The Economy of a Norfolk Fruit Farm, 1923–26." Price 2*s*. net. Postage 2*d*.

Report No. 8. " An Economic and Financial Analysis of Seven Eastern Counties Farms in 1926–27." Price 1*s*. net. Postage 1*d*.

Report No. 9. " Sugar Beet in the Eastern Counties, 1927." (Pp. 106.) Price 3*s*. net. Postage 3*d*.

Report No. 10. " An Economic and Financial Analysis of Fifteen East Anglian Farms in 1926–27." Price 1*s*. net. Postage 1*d*.

Report No. 11. " An Economic and Financial Analysis of Five Eastern Counties Farms in 1927–28." Price 1*s*. net. Postage 1*d*.

Report No. 12. " Four Years' Farming in East Anglia, 1923–27." (Pp.135.) Price 3*s*. net. Postage 3*d*.

Report No. 13. " Sugar Beet in the Eastern Counties, 1928." No. 2. Price 2*s*. 6*d*. net. Postage 3*d*.

Report No. 14. "The Seasonal Distribution of Farm Labour Requirements." Price 2*s.* net. Postage 3*d.*

Report No. 15. "Factors Affecting the Price of Potatoes in Great Britain." Price 2*s.* 6*d.* net. Postage 3*d.*

Report No. 16. "Sugar Beet in the Eastern Counties, 1929." No. 3. Price 2*s.* 6*d.* net. Postage 3*d.*

Report No. 17. "An Economic and Financial Analysis of Sixteen East Anglian Farms, 1927–29." Price 1*s.* net. Postage 1*d.*

Report No. 18. "An Economic Survey of Hertfordshire Agriculture in 1930." Price 2*s.* 6*d.* net. Postage 3*d.*

Report No. 19. "An Economic Survey of Agriculture in the Eastern Counties of England, 1931." Price 2*s.* 6*d.* net. Postage 3*d.*

Report No. 20. "A Survey of Milk Marketing Schemes and Price Policies." Price 2*s.* net. Postage 2*d.*

Report No. 21. "An Economic Survey of Agriculture in the Eastern Counties of England, 1932." Price 2*s.* 6*d.* net. Postage 3*d.*

Report No. 22. "An Economic Survey of Agriculture in the Eastern Counties of England, 1933." Price 2*s.* 6*d.* net. Postage 3*d.*

Report No. 23. "Changes in the Economic Organisation of Agriculture. A comparative study of conditions in the Eastern Counties in 1933 and 1935." Price 1*s.* 6*d.* net. Postage 2*d.*

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The Cambridge Farm Account Book. Price 3*s.* net. Postage 6*d.*

To be obtained from the Farm Economics Branch, School of Agriculture, Cambridge, ENGLAND.

Handbook to the School of Agriculture : containing full information as to the Ordinances governing the teaching, examination and other activities of the School of Agriculture ; and in addition general information concerning the study of Agriculture at Cambridge. Obtainable from the Secretary, Price 2*s.* 6*d.*

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To be obtained from The Secretary, Imperial Bureau of Plant Genetics, School of Agriculture, Cambridge, ENGLAND.

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